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Article

Argas vespertilionis (Ixodida: Argasidae): A parasite of Pipistrel bat in Western Iran

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Abstract

Ticks (suborder Ixodida) ecologically divided into two nidicolous and non-nidicolous groups. More argasid ticks are classified into the former group whereas they are able to coordinate with the specific host(s) and living inside/adjacent to their host's nest. The current study focused on an argasid tick species adapted to bats in Iran. Tick specimens collected on a bat were captured in a thatched rural house located in suburban Koohdasht in Lorestan province, west of Iran. Tick's larvae and nymphs were identified as *Argas vespertilionis* (Latreille, 1796) by using descriptive morphological keys. This argasid tick behaves as a nidicolous species commonly parasitizing bats. We suggest that future studies be conducted on ticks parasitizing wild animals for detection of real fauna of Iranian ticks.

Key words: *Argas vespertilionis*, nidicolous tick, Ixodida, bat, Iran

Introduction

Only 10% of all ticks (suborder Ixodida) including soft ticks (Argasidae) and hard ticks (Ixodidae) may be captured on livestock and domestic animals (Oliver 1989), and remaining species must be searched through wild animals (e.g. birds, mammals, lizards, rodents, even amphibians and the other none-domestic animals). Acarologists need to determine the biological models of tick parasitism on wildlife and the factors that have permitted to less than 10% of all ticks to become economically important pests and vectors of disease agents to livestock and human (Hoogstraal 1985).

Ticks are obligate parasites of vertebrates (including humans) in all terrestrial habitats and are able to feed on blood and lymph of their hosts (Bowman & Nuttall 2008). The major effects caused by ticks in their host can be explained in three different forms as biological vectors for transmission of pathogenic agents (e.g. viruses, rickettsiae, bacteria, protozoa and even fungi), anemia in host and toxicosis (e.g. tick paralysis due to tick saliva) (Sonenshine 1991).

Ticks lifestyle is similar to paurometabolous strategy (i.e. immature stages have appearance and mode of life similar to those of the parents) applied by arachnids and many insects (Sonenshine 1991; Dhooria 2008). Hard and soft ticks have three active

parasitic stages as larva, nymph (only one and more than one nymphal stage in ixodid and argasid ticks respectively), and adult (Sonenshine 1991). Ticks ecologically divided into two nidicolous and non-nidicolous or exophilic groups. Behaviorally, ticks have different strategies based on their ecology. Nearly all soft ticks and hard ticks of the genus *Ixodes* (prostriata) are nidicolous species, unlike usually all other hard ticks (metastriata) that are non-nidicolous species (Walker *et al.* 2007). The characteristics of two lifestyles have more significant effects on habitat requirement, host-finding strategy, feeding behavior and host specificity, survival parameters (especially relative humidity), seasonal activity period, and many ecological adaptation required for tick species in climatic and microclimatic conditions (Sonenshine 1991).

The round bat argasid, *Argas vespertilionis* (Latreille, 1796) (Ixodida: Argasidae), having nidicolous behavior that especially parasitizes bats (order Chiroptera) (Hoogstraal 1958). The species was introduced in former literature as *A.* (*Carios*) *vespertilionis* and classified with many closely related species as *vespertilionis* group (Hoogstraal 1956). The distribution of species due to taxonomic controversy, closely related species and plenty of synonyms was not exactly clear. However, it appears that the species was scattered only in the old world (Hoogstraal 1956; Estrada-Peña *et al*. 2010).

The reason for studying ticks parasitizing wildlife in Iranian territory is due to probable human-tick contact and incidental acariasis by tick species adapted to none-domestic animals. Furthermore, an extensive tick faunal survey will never be completed unless all hosts preferable for tick, including wild animals, are investigated. However, for valuable monitoring tick-borne disease risks, identification and understanding the ecology of all tick species present in a region is an inevitable task. It is necessary to extend collecting ticks from their hosts, especially from wild animals, in order to expand knowledge about the occurrence of ticks in Iran as well as their immature stages, their geographical distribution and comprehensive data regarding their ecology (Abbasian-Lintzen 1960).

Only was the larvae of *A. vespertilionis* already reported from northwest Iran (Darregez town) on the common Pipistrel bat, *Pipistrellus pipistrellus* (Filippova *et al.* 1976). The report by Filippova (1976) was briefly written in two lines and was never detailed or described in a separate publication. Thus, additional larvae, along with nymphs, needs to be reported for Iran. The current study is a new version of occurrence of this nearly neglected soft tick in Iran, with the complementary data.

Ticks of wild animals are poorly studied in Iran and more investigations, with a veterinary approach, have emphasized the livestock ticks. However, some authors have investigated taxonomic, ecological and biological aspects of few wildlife tick species (e.g. Delpy 1947; Hoogstraal & Wassef 1979; Hoogstraal & Valdez 1980; Nabian & Mirsalimi 2002; Rahbari & Nabian 2007; Razmi & Ramoon 2012). The present research may be considered as preliminary study on the bats that serve as host for nidicolous argasid species.

Materials and Methods

Study area

Materials were collected in the June of 2012 at Pariyan village (33°27′41″ N, 47°34′31″ E) located in Koohdasht, Lorestan province in the west of Iran. Lorestan is

separated into four geographical climates, and Koohdasht is situated in semiarid and temperate category.

Bat and tick specimens

One bat was manually captured in a thatched rural house and carefully examined for any external parasite such as ticks. During sampling, special attention was given to ear base, back, neck, and belly of the bat. Engorged ticks were captured using minute forceps and preserved in vials with ethanol 70%.

Some tick larvae were captured alive and maintained under favorable conditions in glass tubes or on their natural host to terminate blood feeding and, after molting, were matured as the next stage. Succeeding hungry nymphs were offered to white hamster to feed and reared in the laboratory. The rest were stored in ethanol 70%. Engorged nymphs were maintained in laboratory conditions, 22–28°C temperature and 80% RH, until molted to nymphal stages 2 and 3.

Bat & tick determination

First, the bat host was identified to the genus level by using Iranian bat's morphological keys (Ziaii 1996). Afterwards, tick specimens were determined according to the criteria which have been described in pictorial literature and morphological keys in Nuttall *et al.* (1908), Neumann (1911), Hoogstraal (1956, 1958) and Filippova (1966). Overall shape and taxonomic characters of ticks were sketched by a drawing tube attached to the Olympus stereomicroscope and some specimens were photographed by a Sony digital camera. Finally, an original key for the identification of Iranian *Argas* (representative subgenera) including *A. vespertilionis* was presented in the current paper.

The tick specimens were deposited in Lorestan tick collection, Lorestan Agricultural and Natural Resources Research Center, Khorram Abad, Lorestan, Iran.

Results

One bat specimen was identified to genus level as *Pipistrellus sp*. (Syn. *Vespertilio* sp.) through such characteristics as size, ear appendage (tragus), teeth row arrangement and other morphological characters. The precise identification of species of the genus *Pipistrellus* is very debatable due to its variability and needs to study teeth row arrangement by specialist (De Blase 1980; Ziaii 1996). The species belongs to the family Vespertilionidae widely distributed in Iran with 22 species (Ziaii 1996).

Nearly 10 attached or strayed tick larvae were collected on the ear base, back, neck and belly of the severely infested bat (Fig. 3). All tick larvae and nymphs collected on bat were identified as *Argas vespertilionis* (Latreille, 1796) (Figs. 1–2). We followed the current nomenclature proposed by Guglielmone *et al.* (2010). Taxonomic characters used for the identification of larvae and nymphs of *A. vespertilionis* are summarized in Table 1.

While rearing in the laboratory, a few nymphs were placed on the mammalian host to feed on and developed as nymphal stage 2 and 3. Unfortunately, we were not able to rear nymphal stage 3 to adult stage.

A key to the identification of soft ticks genus *Argas* (adult ♂/♀) in Iran

1. Body circular (subgenus *Carios*) (Fig 4-I)……...……...….*A. vespertilionis*
- Body oval (Fig 4-II)…….……...…2

2. Margie of body striate, postpalpal hair absent (subgenus *Argas*) (Fig 4-III and Fig 4-V)……..……..…….…*A. reflexus* (Fabricius, 1794)
- Margin of body having quadrangular plates, postpalpal hair present (subgenus *Persicargas*) (Fig 4-IV and Fig 4-VI)……..…..…….....*A. persicus* (Oken, 1818)

Table 1. A set of taxonomic characters used for identification of larva/nymph of *A. vespertilionis* (Iranian specimens).

Character	Life stages	
	Larva	Nymph
dorsal plate	○	
hypostome dentation 2/2	○	
cone-like hypostome	○	
lacking tarsal hump	○	•
one pair post-palpal seta		•
one pair post-hypostomal seta		•
lateral suture		•
body circular or subcircular in outline		•
coxae are contiguous		•
ventral transverse accolade furrow		•
radiating dorsal chainlike lines comprising series of discs		•
legs arise from lesser than anterior half of the body		•
legs are shorter than the body		•

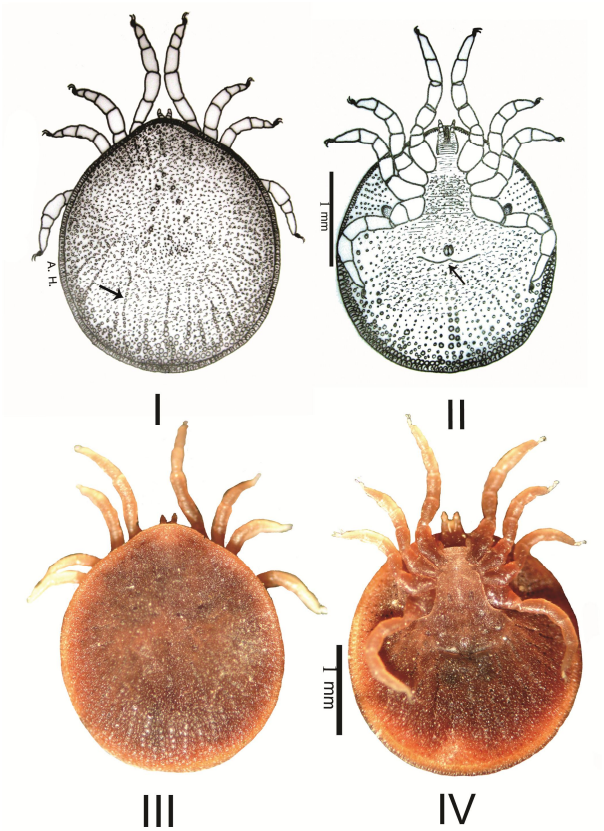

Figure 1. *Argas vespertilionis* nymph stage 2. Upper (drawing): I) dorsal view (arrow indicates radiating dorsal chainlike line), II) ventral view (arrow indicates post anal transverse accolade furrow). Lower (photograph): III) dorsal view, IV) ventral view.

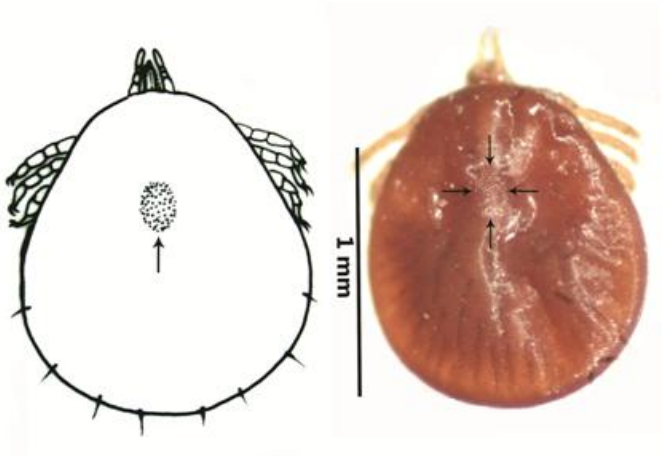

Figure 2. Dorsal view of *Argas vespertilionis* engorged larva; left (drawing) and right (photograph) (arrows indicate squamous dorsal plate).

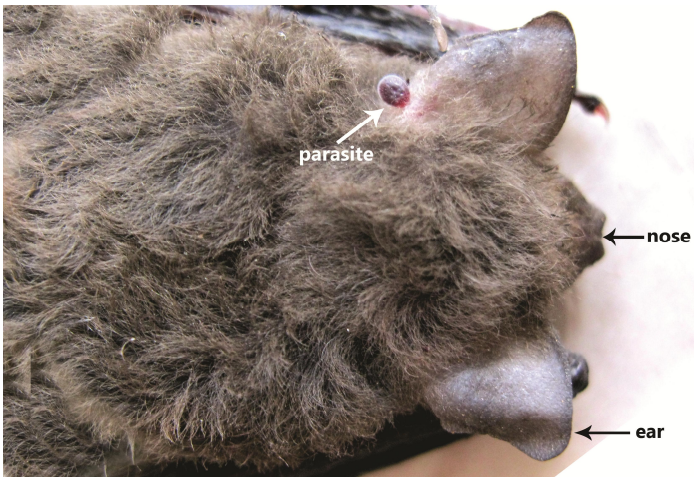

Figure 3. Dorsal view of bat host parasitized by *Argas vespertilionis* engorging larva; different parts of bat and parasite attachment site are determined by arrow.

Discussion

Taxonomic consideration

Argas vespertilionis belongs to the species subgenus *Carios* that are circular or subcircular *Argas*-like ticks in outline unlike subgenus *Persicargas* that are sub-oval in general shape with representative species *A.* (*Persicargas*) *persicus*, which is a cosmopolitan tick and has a formidable history in old Iran (Persia) (Nuttall *et al.* 1908). The round bat *Argas* was originally named as *Carios vespertilionis* in the earlier literatures when *Carios* upgraded to the genus level (Camicas *et al*. 1998). Audouin in 1827 and 1832 (Hoogstraal 1956) described *A. fischeri* and *A. pipistrellae* respectively that may now be regarded as synonyms of *A. vespertilionis* (Camicas *et al*. 1998). However, Camicas *et al*. (1998) believed that *A. fischeri* could be as a distinct identity. Hoogstraal (1956) classified three *Argas* species namely *A. boueti*, *A. confusus* and *A. vespertilionis* in the *vespertilionis* group based on outline body shape, closely related characteristics and their same host (Hoogstraal 1956). Nuttall *et al*. (1908), Hoogstraal

(1958) and Filippova (1966) described all parasitic stages of *A. vespertilionis*, especially Hoogstraal's study which accurately compared tick variation in some populations of the species (Nuttall *et al.* 1908; Hoogstraal 1958; Filippova 1966).

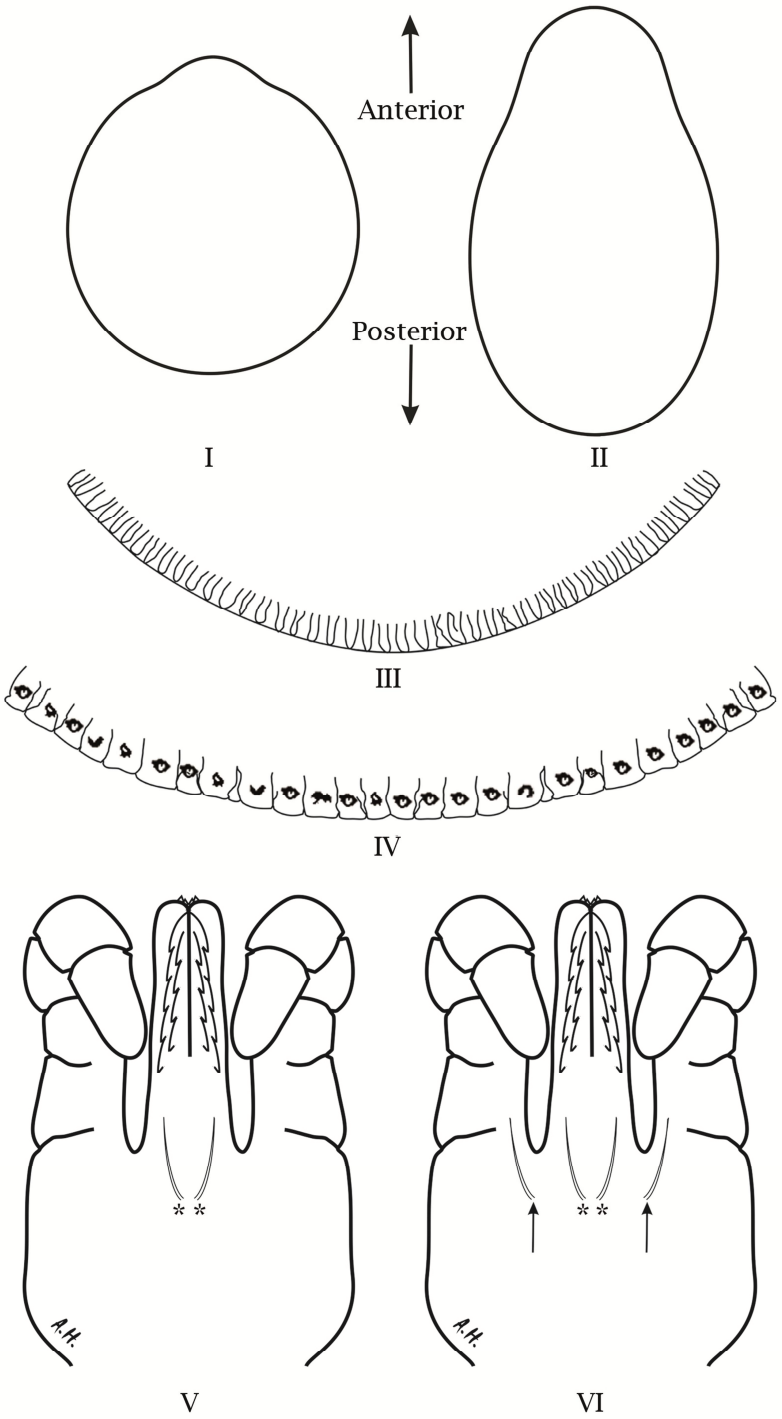

Figure 4. Key characteristics of three Iranian *Argas* species; I-II) total body shape, III-IV) margin of body, V-VI) post-palpal setae (arrows) and post-hypostomal setae (asterisk).

Medical implication

Bats are small mammals that almost found throughout the world, the most distributed living organisms indeed behind humans (Ziaii 1996). Thirty eight bat species are reported from Iran, so that many species live near human buildings (De Blase 1980). Some bat species are adapted to human buildings and tend to construct their nests under a wooden roof of the patio or adjacent to human restroom. Therefore, hungry ticks parasite of bats in these areas may attach to humans. Despite human infestation cases by *A. vespertilionis* reported in the early studies (Hoogstraal 1956), to date there have not been enough studies on ticks infesting bats or other wildlife, especially those in close contact with human buildings or scattered in husbandry fields, for instance, rodents.

Attacks by nymphs and adults of *A. vespertilionis* to man were reported in the laboratory as well as in caves where bats habituate (Hoogstraal 1956). Also, our observation supported Hoogstraal's finding so that we recorded a case of human acariasis on hand of first author during the laboratory rearing and mild itching persisting for several days (data not shown). In 1973, tick-borne and mosquitoe-borne virus Issyk-Kul disease was simultaneously isolated from tick *A. vespertilionis* and bats *Nyctalus noctula* (Schreber, 1774), *Pipistrellus pipistrellus* (Schreber, 1774) and other species in Kyrgyzstan (Gavrilovskaya 2001) (See Lvov *et al*. 1973). Gavrilovskaya (2001) declares that ticks were able to penetrate into houses and attach to humans (Gavrilovskaya 2001). Most human cases of Issyk-Kul viral disease occur in June-August in Kyrgyzstan, which coincides with the peak of tick activity. Recently, some *Rickettsia*, *Borrelia* and *Ehrlichia* species, isolated from *A. vespertilionis* ticks, were collected in France close to human dwellings, e.g. bedroom (Socolovschi *et al*. 2012).

We propose that future studies are required to determine variation in the taxonomic characters of the adult stage through collecting or rearing specimens. Also, a survey on the establishment of *A. vespertilionis* in a greater area in the Iranian territory is needed. Since ticks specifically parasitized bat species established to human buildings, caves or other natural habitats so that potentially may be the vector of Arboviruses, thus their medical and veterinary implications required to be investigated.

Conclusion

Iranian soft ticks usually live inside the nest/shelter of their host, e.g. *Argas persicus* (parasite of poultry), *A. reflexus* (parasite of pigeon), *Ornithodoros erraticus* (Lucas, 1849) and *O. tartakovskyi* (Olenev, 1931) (parasite of rodents), *O. lahorensis* (Neumann, 1908) and *O. canestrinii* (Birula, 1895) (parasite of livestock), and now *A. vespertilionis* is reported as a parasite of Pipistrel bat. Attention may be paid to where we observed that *A. vespertilionis* is capable to attack human and successfully molt to the next stage. Since ticks specifically parasitized bats that established to human buildings, caves or other natural areas, it may contribute to the transmission of tick-borne disease agents to humans. Therefore, ticks infesting wild animals, such as bats, require to be investigated in Iran.

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گونهٔ *Argas vespertilionis* (Ixodida: Argasidae): انگل خفاش پیپسترل در غرب ایران

اسدالله حسینی‌چگنی و مجید توکلی

چکیده

کنه‌ها (زیرراسته Ixodida) از نظر اکولوژیک به دو دسته آشیانه‌زی و غیر آشیانه‌زی تقسیم می‌شوند. بیشتر کنه‌های نرم در گروه اول قرار دارند به طوری که می‌توانند با میزبان(ها) خاص خود سازش یافته و درون یا نزدیک لانهٔ میزبان خود زندگی کنند. مطالعه حاضر، دربارهٔ یک گونه کنه نرم سازگار با خفاش‌ها در ایران است. نمونه‌های کنه از روی یک خفاش، صید شده در یک خانه روستایی کاه گلی واقع در حومه شهر کوهدشت در استان لرستان، غرب ایران جمع‌آوری شدند. لارو و پورهٔ کنه با استفاده از کلیدهای شناسایی توصیفی به عنوان *Argas vespertilionis* (Latreille, 1796) تعیین هویت شدند. این کنه نرم به صورت یک گونهٔ آشیانه‌زی رفتار می‌کند و به‌طورمعمول انگل خفاش‌ها است. پیشنهاد میشود که مطالعات بیشتری در مورد کنه‌های انگل حیوانات وحشی، برای تعیین فون حقیقی کنه‌های ایران انجام شود.

کلید واژه‌ها: *Argas vespertilionis*، کنهٔ آشیانه‌زی، Ixodida، خفاش، ایران

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